[Fig.1]

1: controller

2: servo drive (two set)

3: moving element

4: stator

5: linear scale

6: fastening jig

A1: front view

A2: side view

A3: plan view

[Fig. 2]

11: main position command generation

12: interpolation (position command generation)

13: phase lead

14: function for generating torsion part corrected value

17: scale conversion

18: Ktff gain

2-1: servo drive of first axis

2-2: servo drive of second axis No.2-axis servo drive

(to the same control block as described below)

21: position loop

22: speed loop

23: current loop

24: linear scale

A1: torsion part corrected value

A2: quantity of correction of manual operation Pr

A3: to No.2-axis T-FF

[Fig.3]

Step 1: Return to the origin

The position of the first axis as the main axis is controlled and the other axis is allowed to freely run and reset to zero.

Step 2: Measurement of torsion data between two axes

A method is carried out in which a deviation between two axes (position FB of first axis - position FB of second axis) is automatically measured at an arbitrary pitch to store the deviation in a data base. At this time, when the two axes are electrically operated at the same time under a speed control and a position control like during the return to the origin operation, a motor of each axis gives a stress to a machine side. Thus, characteristics such as the distortion of the machine itself cannot be grasped. Accordingly, in driving during the measurement, the main axis (any one of the two axes may be used) is operated at low speed by controlling a position and the other axis is allowed to freely run and follow the main axis to measure the deviation of the two axes.

Step 3: Generate function of torsion data

A function is generated that has a travelling position as an input and the deviation between the axes measured in the step 2 as an output. Since the input arbitrarily changes depending on a moving distance, the deviation measured at the arbitrary pitch in the step 2 is subjected to a linear interpolating process in the function and the obtained deviation is outputted.

[Fig. 4]

A: measured value by laser displacement gauge

B: measured value by controller

A1: comparison of measured torsion

A2: deviation between axes

A3: position of Y-axis

[Fig. 5]

1: main position command

2: main torque command

3: torque command of correcting side

4: deviation between two axes (maximum value of 30 μm)

[Fig. 6]

1: main position command

2: main torque command

3: torque command of correcting side

4: deviation between two axes (maximum of 11 μm)

[Fig. 7]

31: generation by controller

32: interpolation

39: position of X-axis

40: Gain is changed at a position of the X-axis of a function for generating an inertia compensating gain. An inclination may be based on the change of a load exerted on the axis due to the change of a center of gravity.

36: y1-axis torque FF [y1-axis torque compensation

38: y2-axis torque FF [y2-axis torque compensation]

35: (((Wwy1' + Wt + Wm) x acceleration αref + FL)/rated thrust) X 100 %

36: (((Wwy2' + Wt + Wm) x acceleration αref + FL)/rated thrust) X 100 %

A1: accelerating and decelerating time

A2: 24msec/100% speed

A3: S character time (10msec)

A4: speed command

A5: position command

A6: adjusting coefficient

A7: movable range of X-axis

A8: diagram viewed from above

A9: center

A10: maximum width

A11: position X of X-axis

[Fig. 8]

X: position of X-axis

Xmid: neutral position of X-axis

A1: Y1-axis inertia compensating gain Ktffy1

A2: Y2-axis inertia compensating gain Ktffy2

A3: adjusting coefficient

[Fig. 9]

1: main position command

2: torque FF of Y1 side

3: actual torque command of Y1 side

4: deviation between two axes (maximum value of 112 μm)

[Fig. 10]

1: main position command

2: torque FF of Y1 side

3: actual torque command of Y1 side

4: deviation between two axes (maximum of 20 μm)